Brian Bowers. *Sir Charles Wheatstone, F.R.S., 1802–1875.* vii + 226 pp., 17 plts., appendix, index. London: Her Majesty's Stationery Office, 1975. £ 5.50 (paper).

Charles Wheatstone did not rank among the top Victorian scientists, yet his varied career and contributions pose fascinating questions about the pursuit of science in the period. By turns natural philosopher, inventor, entrepreneur, Wheatstone strains traditional classification. In his biography of Wheatstone, Brian Bowers, an electrical engineering curator at London's Science Museum, touches upon but chooses not to deal with these ambiguities. Instead, emphasizing material sources at hand, he anchors his biography to the concrete products of Wheatstone's career: his scientific instruments and inventions. Bowers clearly shows Wheatstone to be one of the inventive geniuses of his generation. Fortunately, many examples of Wheatstone's devices (electrical measuring apparatus, motors, generators, telegraphs) survive, chiefly at King's College, London, where Wheatstone experimented and occasionally lectured, and at the Science Museum.

Bowers documents the instruments associated with each stage of Wheatstone's career, places them in historical context, and even subjects selected items to engineering analysis. Bowers concludes that Wheatstone was never a profound or especially original natural philosopher. Rather, he possessed an encyclopedic knowledge of current developments and excelled at publicizing and extending the work of others. Wheatstone pioneered in introducing Ohm's law to his English-speaking colleagues. Also, Bowers shows the Wheatstone bridge to be an improvement on an earlier, less-well-known measuring circuit invented by S. Hunter Christie.

Wheatstone's interests in science and invention were extraordinarily wide. Bowers does us the service of showing linkages between disparate researchers and instruments, effectively countering the common impression among Wheatstone's contemporaries that his was a dazzling but inconsistent talent. For example, one sequence leads from Wheatstone's tinkering with musical instruments in the family business (a prolific inventor of musical devices, Wheatstone patented a concertina in 1829) to his acoustical researches, his concerns with transmission of signals, and finally to his sustained groundbreaking effort in electrical telegraphy. Motivated by a continual curiosity about underlying principles, Wheatstone in effect followed a career-spanning research program.

Bowers' book should be seen primarily as hardware history; as such it is an interesting and valuable resource for understanding Wheatstone and engineering developments of the period. As biography, however, Bowers' effort is disappointing. Details of Wheatstone's life are derived mostly from obvious published sources. The result is a somewhat lifeless narrative in which the figure of Wheatstone appears less animated than the mechanisms he produced.

This is a pity, since there is a lot in Wheatstone that is fascinating. Bowers' account hints at a number of basic issues but never confronts them squarely. An obvious example is the problem of Wheatstone's dual output, his scientific publications and an equally impressive string of patents. Clearly unifying these theoretical and practical activities was Wheatstone's streak of playfulness; he took equal delight in constructing philosophical toys and inventions. Scientific self-education melded to an apprenticeship in the musical

instrument shop reinforced these dual inclinations. Wheatstone, however, viewed himself as a scientist (although he referred to himself throughout his life as a "musical instrument maker"). This is demonstrated in his uneasy collaboration on the telegraph with the entrepreneur Cooke. During their partnership, disputes arose over credit due to Wheatstone's "scientific" versus Cooke's "practical" contributions. Interestingly, similar tensions disrupted the contemporary relationship in America between Joseph Henry and S. F. B. Morse.

There is perhaps a lesson to be learned here about the dynamics of scientific technologies in the nineteenth century. Wheatstone's apparently odd mixture of interests falls into place within the framework of Victorian technologies. His invention of elementary talking machines, his avid interest in linguistics, his work with musical machines, his acoustical and electrical experiments formed a potential critical mass. A similar array of involvements were integral to the achievements of Alexander Graham Bell.

As Bowers documents, Wheatstone was active in areas beyond the King's College laboratories. He was deeply involved in commercial ventures and government consulting—for example, in submarine telegraphy. Wheatstone's peculiar talents and interests happened to match contemporary public needs; it was probably not coincidental, however, that he kept meeting illustrious colleagues like Faraday in these public contexts. In other words, aspects of Wheatstone's seemingly unorthodox career may serve as a useful model for understanding some of the complexities of his era.

Issued in paperback, profusely illustrated, its technical points nicely laid out, Bowers' book is certainly an accessible one. But as a general introduction to the life and times of Wheatstone, it falls short. Furthermore, Bowers' citations pose major obstacles to using his book as a starting point for further study. Rather than specific documentation, Bowers gives us a few catch-all footnotes vaguely covering entire chapters of his text. For Wheatstone and his times to come alive, the reader will have to do a good deal of guessing and searching anew.

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